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(54) Name of Invention: Stable Multifrequency Driving Device for an Acousto-Optic Element

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Specification

Name of Invention

Stable Multifrequency Driving Device for an Acousto-Optic Element

Patent Claims

A stabile multifrequency driving device for an acoustico-optical element, in a recording device using a method wherein multiple carrier waves are modulated by multiple modulators depending on respective multiple image signals, where the acoustico-optical elements split a light beam from a light source into multiple beams for simultaneous modulation, including a means for detecting the intensities of each specific modulated beam from said the acoustico-optical element, means for comparing the various detected outputs from said that means and the aforementioned image signals, and means for performing gain control on the respective outputs from the aforementioned multiple modulators based on the respective comparison outputs of said means.

Detailed Explanation of the Invention

The present invention relates to stable devices for multifrequency driving acoustico-optical elements in recording devices such as laser printers, laser COMs [TRANSLATOR'S NOTE: PERHAPS AN ABBREVIATION FOR "computer-output microfilm systems"], and laser copiers.

In the laser recording device, a laser beam is split into multiple beams, [which are] modulated simultaneously, where the modulated beams are scanned simultaneously over multiple lines of a photosensitive material. This is an important technology from the perspective of achieving high speeds. Multifrequency driving acoustico-optical elements are conventionally well-known as elements for dividing laser beams into multiple beams and then performing simultaneous modulation. However, in the normal method of using these multifrequency driving acoustico-optical elements, multiple modulation signals are driven simultaneously, and thus there is a weakness in that, depending on the data, the strength of the optical modulation will be influenced by other data, causing intermodulation, leading to non-uniformities in image, making it difficult to display gray levels. The method of minimizing the intermodulation through the provision of a compensation beam is disclosed in Japanese Examined Patent Application Publication S 51-75541, as a conventional technology for compensating for this weakness. However, because, in this technology, the multifrequency driving acoustico-optical element bands are not perfectly flat, it is not possible to compensate perfectly for the intermodulation, and there are drawbacks such as not being able to compensate for the γ characteristic of the multifrequency-drive acoustico-optical elements, and drawbacks in that there are variations in the intensity of the laser light source.

The object of the present invention is to provide a device with a stable multifrequency-drive acoustico-optical element that compensate for the deficiencies described above through determining the intensity of the modulated light from the acoustico-optical element and through negative feedback to the acoustico-optical element drive system.

An example embodiment of the present invention will be described below, while referencing the drawings.

This example embodiments is an example wherein the present invention is applied to a laser recording device wherein three beams are modulated simultaneously. As is shown in FIG. 1, the carrier waves with frequencies f_1 through f_3 from the high-frequency oscillators 1 through 3 are each AM modulated into image signals by the image signal generator 7, comprising a central processing device or a scanner in each of the respective AM modulators 4 through 6. The output signals from these AM modulators 4 through 6 are mixed in a mixer 11, after having passed through the respective automatic gain control circuits (hereinafter termed "AGC circuits"), and are then applied to the acoustico-optical element 12. The laser beam from the laser oscillator 13 is divided into multiple beams by the multifrequency-drive acoustico-optical element 12, at which time they are simultaneously modulated. The zeroeth-order beam I_0 from the acoustico-optical element 12 is cut by a stopper 14, and the modulated beams I_{+11}, I_{+12}, and I_{+13} from the acoustico-optical element 12 are, in the greater part thereof, passed through the a half mirror 15, to be guided to the photosensitive material to form a latent image. Developed, transfer, and the like, are performed by devices that are not shown, to record an image.

On the other hand, each of the modulated beams from the acoustico-optical element 12 are, in a portion thereof, reflected by the half mirror 15 to impinge on the respective beam detectors 16 through 18, where they undergo optical-electronic conversion to form negative feedback signals. The output signals from these beam detectors 16 to 18 are compared to the corresponding positive signals from the signal generator 7 in comparators 19 to 21, and, depending on the output signals thereof, negative feedback is applied to the AGC circuits 8 to 10. In the AGC circuits 8 to 10, as shown in FIG. 2, there is a linear relationship between the feedback signal and the gain characteristics, and negative feedback is applied so that the resulting image signals will be equal to the negative feedback signals. In this way, it is not only possible to fully prevent the intermodulation of the acoustico-optical element 12 through the application of negative feedback, but also to fully compensate for the output variations of the laser oscillator 13, and for the γ signal characteristics of the acoustico-optical element 12.

Note that the acoustico-optical element essentially is a delay element, and when there is a large distance between the transducer and the laser beam input position, the modulation frequency characteristics will be bad. Consequently, when negative feedback, such as described above, is applied, preferably the modulation frequency characteristics will be improved through shortening the delay time through having the laser beam incident position being near the transducer 12_1 in the acoustico-optical element 12. Furthermore, as is shown in FIG. 3, even if the acoustico-optical element is used in a black region, the negative first-order beams L_{11}, L_{12}, and L_{13} will be outputted, and these will correspond to the positive first-

order beams I_{+11}, I_{+12}, and I_{+13}, as shown in FIG. 4. Given this, in the example embodiment described above, the positive first-order beams I_{+11}, I_{+12}, and I_{+13} may be detected by the beam detectors 16 to 18 detecting, as shown in FIG. 5 the negative first-order beams I_{-11}, I_{-12}, and I_{-13}, or, as shown in FIGS. 6, the negative first-order beams I_{-11}, I_{-12}, and I_{-13} may be directed to the beam detectors 16 to 18 by the mirror 22.

Because, as described above, in the device wherein the multifrequency drive acoustico-optical element 12 is stable according to the present invention, the intensities of the various modulated beams from the acoustico-optical element are detected and negatively to the fed back to the acoustico-optical element drive system, it is not only possible to adequately compensate for intermodulation in the acoustico-optical element, but also possible to adequately compensate for variations in the output of the light source.

Simple Explanation of Drawings

FIG. 1 is a system diagram showing an example embodiment of the present invention.
FIG. 2 is a characteristic drawing of the AGC circuits in the same example embodiment.
FIGS. 3 and 4 are drawings for explaining the present invention.
FIGS. 5 and 6 are system diagrams showing portions of other example embodiments.

1-3: HIGH-FREQUENCY OSCILLATORS
4-6: MODULATORS
7: IMAGE SIGNAL GENERATOR
8-10: AGC CIRCUITS
11: MIXER
12: ACOUSTICO-OPTICAL ELEMENT
13: LASER OSCILLATOR
15: HALF MIRROR
16-18: BEAM DETECTORS
19-21: COMPARATORS
22: MIRROR

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FIG. 1
[INSERT FIGURE]

FIG. 2
[INSERT FIGURE]
[VERTICAL AXIS] Gain
[HORIZONTAL AXIS] Feedback signal

FIG. 3
[INSERT FIGURE]

FIG. 4
[INSERT FIGURE]
[VERTICAL AXIS] Modulated beam intensity
[HORIZONTAL AXIS] Inputted power

FIG. 5
[INSERT FIGURE]

FIG. 6
[INSERT FIGURE]